The
Philippine Agriculturist

VOL. XI, NO. 1 AUGUST, 1922

EDITORIAL

PROFESSOR EMMA SEREPTA YULE

In April Professor Yule left the College, on a year's well-earned leave. It is only after a useful member of the faculty has departed that we appreciate clearly, and in proper perspective, what we have lost.

Professor Yule joined the College in 1917, when there was a still greater discrepancy between number of teachers and number of students than at present, and when the burden of teaching was excessively heavy. She took up the work as she found it, cheerfully, and with the most genuine interest. Her personal interest in the students individually was always keen and helpful. The boys felt and appreciated this, and the response was ready and whole-hearted. So it is that a great teacher can get splendid and satisfying results where others might look at it as impossible and hopeless. With her many years of teaching experience, Professor Yule accepted the very difficult student material we have to handle as a constant challenge, and gave a large amount of time and thought to devising work and courses that would be specially and peculiarly adapted to our particular needs. Very different, this, from the attitude of some teachers who say "I teach it as it ought to be taught—if they don't get it, it is no fault of mine!"

In addition to her work as a teacher, Professor Yule carried a large amount of other work necessary to the operation of the College. For years she read all the senior theses for English—a very heavy burden. But it was a profitable burden to her, since out of it, and with the co-authorship of Dr. Trelease, grew the little volume on "The Writing of Theses and Technical Papers," which is now a standard for us and for many other institutions. A considerable order for this work recently came from Johns Hopkins University.

Professor Yule was also the English editor of the College Journal and always found time, somehow, to do the large amount of copy and proof work that this onerous task involved. She always carried home large bundles of theses, themes, copy, and proofs for night work.

Professor Yule's original work was largely confined to studies of oriental womanhood, and folklore, and her writings on these and kindred subjects are now well known, having appeared in the foremost magazines of America. Her point of view is an original one, and her style rich in individuality—and these combine to make her a successful writer on any subject that she attacks—and much in demand.

Professor Yule was of Scotch blood and Puritan stock; we will not forget the inflexibility of her opinions, and the finality of her judgments! But these same qualities helped to make her the great worker, the conscientious teacher, and the loyal college professor that she was. The College owes much to Professor Yule, and cannot afford to lose her.

CHARLES F. BAKER,
Dean, College of Agriculture.

THE ANATOMY OF A DOUBLE PIG[1]

By MANUEL D. SUMULONG
Of the Department of Veterinary Anatomy

WITH THREE PLATES

The specimen that is the subject of this paper was received by the writer on February 6, 1922, from Mr. Villadolid, graduate assistant in the Department of Entomology, College of Agriculture. It was presented to the department by a student about the middle of June, 1921, and preserved in 80% denatured alcohol containing little formalin. According to Mr. Villadolid the pig was born at full term and alive, but survived only for a short time.

With the exception of the distal third of the extremities, the pig was covered with black hairs. It weighed one hundred and ninety grams after having been preserved for about nine months. The right and left bodies were of equal length, being ten and a half centimeters each in crown-rump measurement. Undoubtedly, the pig was very much smaller than the rest of the litter. The average weight of normal, recently born native pigs is three hundred grams, and the average body length is sixteen centimeters.

According to Marchand's scheme of classifying malformations involving more than one individual, given by Bailey and Miller (1), double monsters fall into SYMMETRICAL DUPLICITY, where both bodies are equally developed and derived from originally similar and symmetrical anlagen within one ovum, and ASYMMETRICAL (PARASITIC) DUPLICITY, where one of the bodies, derived from originally dissimilar and asymmetrical anlagen, is always rudimentary and dependent on the other for its nutrition. Under symmetrical duplicity are included *complete duplicity*, in which the bodies may be distinct and separate, and *incomplete duplicity*, in which the bodies may be joined together to a greater or lesser extent. The present example belongs to incomplete duplicity, and falls readily into its subdivision, *syncephalus thoracophagus*, where there is a ventral union involving the head, neck and thorax.

The determination of the causative factors underlying the origin of complete or incomplete duplicities, has been, and still is, one of the most difficult and vexed problems of teratology, toward the solution of which many theories have been formulated. Among the theories are two decidedly opposed ones which have prevailed within recent years—the "fusion" theory and the "fission" theory.

Piersol (2) concisely and clearly explained these two theories as follows:

> "The present conception of fusion theory recognizes the presence of two originally distinct anlagen within a single ovum; these anlagen may remain separate and develop independently leading to the formation of twins, or they may come in contact during growth and undergo more or less external union, thereby producing some variety of double monster.
>
> "The fission theory regards the duplicity as the result of cleavage of a single anlage during the very earliest stages of development, before the formation of the primitive streak. The earlier the cleavage, the more complete the division of the anlage, or conversely, the longer deferred, the more incomplete the fission."

1 Experiment Station contribution, No. 87.

The unusual presence of a large hepatic tissue traversing the median plane of the common abdominal cavity and connecting two small hepatic masses or lobes, the possession of a compound stomach, and the asymmetrical attachment of the costal cartilages to their corresponding sternum, as will be noted in the following description, may suggest that this double monster was in the process of fusion.

Although teratological literature is replete with descriptions of double monsters in the domestic animals, yet the writer was not able to find a single syncephalic case recorded that the anatomical peculiarities coincide entirely with those of the monster pig here studied. Of the syncephalic cases, to which he had access, two that show close resemblance to the specimen here presented will be described.

E. Carey (3) dissected a double pig presenting the following characteristics: The head was compound with a ventral compound face and a dorsal rudimentary one; presence of four nostrils on the snout. The mesio-cephalic aspect of the fused heads presented a hairless oval pit indicating the end of the proboscis of a cyclops. There were dorsal and lateral pairs of ears; those of the dorsal pair were smaller and found close together at the base of the skull. The bodies were joined venter to venter and the fusion extended backwards to the umbilicus. Only a single umbilical cord with four arteries and two veins was present. There were two sets of anterior limbs; and ventral and dorsal pairs of lungs, each of which was connected by a trachea to its corresponding larynx. The tongue was compound and the alimentary tract was single to within sixteen centimeters of the caecum, at which point the ileum bifurcated. The liver, pancreas, spleen, and the genito-urinary system were double. The right thyroid gland was absent from its normal position in the neck. There were dorsal and ventral hearts, each possessing a separate pericardium. Foramen ovale existed in each heart, and each right auricle received two anterior and one posterior vena cavae. Two complete cerebro-spinal axes were present; the fusion of the right optic nerve of the left encephalon and the left one of the right encephalon to form a common trunk represented the only connection between them.

The double pig described by Williams and Rauch (4) differed chiefly from Carey's specimen in the following respects: The head appeared more nearly normal, with but two ears and two nostrils. The dorsal side of the head showed a mass of wrinkled skin representing the rudiment of a face, under which was a fontanelle. The pharynx was divided by a connective tissue partition extending from its roof to the floor. There was but one spleen, one pancreas, and one liver. A fused heart with a single venous system and a large aorta to the body on the opposite side arising from each ventricle was present. The aorta from the right ventricle sent no branches further forward than the anterior limbs. There was a ventrally lobed lung mass with a single trachea. The cerebrum was single but the cerebellum presented three lobes. The medullas were fused anteriorly to each other.

It will be noted in the following text that the chief differences from above description by Carey will be encountered in the nervous and blood-vascular systems; and from that by Williams and Rauch, in the blood-vascular system, especially in the heart, and in the respiratory organs.

A partial list of authors consulted is the following: Wymann (5); Pilcher (6); Mitchell (7); Wilder (8); Mall (9); Chauveau (10); Reese (11 and 12); Sisson (13); Tannreuther (14); Thuringer (15).

TOPOGRAPHICAL ANATOMY

(Plate I, Figs. 1 and 2)

Like that of the specimen of Williams and Rauch, the head is single and appears normal in shape and size. The skin and hairs covering it show nothing unusual. The snout has but two nostrils, and the face is well developed and bilaterally symmetrical, presenting no indication that it is of double origin. There are two fully developed lateral ears and a dorsal rudimentary one (1, Figure 1.) The latter is located at the highest point of the head and consists of a fold of skin, somewhat bean-shaped in outline, the free upper border of which is notched, indicating the fusion of the right external ear of the left body and the left external one of the right body. Dissection of this rudimentary ear and its underlying tissues revealed the absence of the corresponding middle and internal ears.

Upon palpation of the dorso-medial surface of the head, a little above the roots of the supraorbital processes, a rather soft area, free from underlying bone, was detected; and upon dissection there proved to be an irregularly oval opening, due to the failure of the parietal bones to fuse in the median line, and that the skin covering it was intimately adherent to the dura matter of the cerebrum.

There are present ventral and dorsal sets of fully and equally developed anterior limbs. The shoulder of each ventral anterior limb is closely applied to the angle of the jaw on the corresponding side. On the other hand, the shoulders of the dorsal anterior limbs are very much approximated to each other in the mid-dorsal line, forming the highest point (2, Figure 1) of the back of the animal.

The bodies are joined by their ventral aspects, and the union extends from before backwards to the common umbilicus, from which point caudad the two separate bodies are perfectly normal. There is present but a single umbilical cord (1, Figure 2) with four arteries and only one large vein.

INTERNAL ANATOMY

THE RESPIRATORY SYSTEM

(Plate II, Fig. 1)

The thoracic cavity, which is common to both right and left bodies, is separated from the abdominal cavity by a single diaphragm. The latter structure is pierced by four foramina—left hiatus aorticus, right hiatus aorticus, foramen venae cavae, and a large foramen through which pass parts of the abdominal organs into the thorax, thus presenting a condition known as diaphragmatic hernia.

Two pairs of lungs, ventral (1) and dorsal (2) are present. Each pair is connected by an abnormally short trachea to its corresponding larynx. The right lung of the ventral pair corresponds to the right side of the right body and the left one, to the left side of the left body; the reverse holds true with the lungs of the dorsal pair, viz., the right lung, to the left side of the right body and the left one, to the right side of the left body. Only the lungs of the ventral pair are lobulated, having three lobes on the right and two on the left.

The dorsal larynx (3) is about half the size of the ventral one (4), and its dorsal aspect is directed ventrad instead of dorsad. Thus the epiglottic cartilages (epiglottes) of the dorsal and ventral larynges, when viewed thru the mouth, are

seen to have their pharyngeal or posterior surfaces directed toward each other. The thymus is apparently normal for a single individual. There is not a single thyroid gland present in the normal position in the neck.

Examination of the oral cavity revealed the presence of "cleft palate," due to the failure of complete development and fusion of the palatine processes of the maxillary bones. Besides, there was seen a globular mass of tissue, about one-half centimeter in diameter, attached by a short stalk to the median line of the posterior part of the roof of the bucco-nasal cavity, at the level of the tip of the dorsal epiglottis. Upon dissection the stalk was found perforating the body of the sphenoid bone at its middle and connected to the ventral surface of the brain. Section of the globular mass of tissue proved that it was pituitary body.

THE DIGESTIVE SYSTEM

(Plate II, Fig. 1)

The tongue was single, and presented numerous and abnormally large villiform projections at the border of the tip and a mediam ridge which fitted into the cleft palate. About one centimeter behind the central circumvallate papilla, there was seen a club-like structure, about one centimeter in length, which upon section proved to be thyroid gland.

The stomach is compound, and consists of two unequal divisions, right and left. The division is indicated externally by a longitudinal constriction. Possibly this may suggest that the stomach is of double origin, viz., the fusion of the stomach of the right body and that of the left one. The right division (5) is larger than the left one (6) and is compressed from before backward; into it opens the oesophagus (7) which lies a little to the right of the median plane. The left division curves forward and passes through a large foramen in the diaphgram into the thoracic cavity. Undoubtedly, this condition was brought about by the pressure exerted by the developing liver. To the greater curvature of the small (left) division is attached the ventral spleen (8).

The small intestine leaves the middle of the posterior wall of the stomach almost exactly at the region of the constriction; its pyloric opening lies entirely to the left of the median plane. It makes twenty-six coils, mostly transverse, before it bifurcates, and its length from its origin to the bifurcation (9) is thirty-seven centimeters. Each of the branches has a length of fifteen centimeters and makes nineteen coils before it terminates into its corresponding caecum, which is the beginning of the large intestine. From the caecum (10) to the anus each of the two separate large intestines is normal for the corresponding body; and it is measured seventeen centimeters in length and makes fifteen coils.

The liver is single, and presents but three masses or lobes which are called here—the right dorsal (11), ventral (12) and left dorsal (13); the ventral lobe is considerably the largest. It is abnormally large for a single individual and occupies a very unusual position. It extends from the diaphragm anteriorly to the region of the umbilicus posteriorly, and fills almost the entire lower third of the compound abdominal cavity. Dorsally it is related to the intestines and ventrally, to the abdominal wall to which it has no attachment. The large umbilical vein (14) serves as its only attachment to the umbilical region. The anterior portion of the left dorsal lobe accompanies that portion of the stomach that projects into the thoracic cavity, as already referred to above. The gall-bladder is absent, and

the bile duct (15) opens into the duodenum about four and a half centimeters from the pylorus.

There is but one pancreas (16). It is situated on the left side of the right body, to the wall of which it is closely applied. It is attached to the dorsal wall of the right division of the stomach by connective tissue strands. The pancreatic duct (17) opens directly into the stomach, and its opening is guarded by two rudimentary valves.

THE URO-GENITAL SYSTEM

Upon examination of the fairly well developed external genitalia, both bodies proved to be female; this being verified by dissection. The uro-genital organs are double and normal for each body.

THE BLOOD-VASCULAR SYSTEM

(Plate II, Fig. 2)

The hearts.—There are two hearts present, each of which possesses a distinct and separate pericardium. The ventral heart (1) is muscular and well developed, and is twice as large as the dorsal heart (2) which is only membranous in structure. They both lie entirely in the median plane; the dorsal being related to the roof of the thorax and the ventral, to its floor. The anterior surface of the ventral heart projects beyond the anterior borders of the first ribs, and is related to the thymus masses. Its unusually blunt apex lies opposite the articulation of the third and fourth sternebra.

The auricles of the dorsal heart are distinct but unequal in size, the right auricle being the larger. They are completely separated by a thin membranous partition and communicate freely with the ventricles by means of the right auriculo-ventricular foramen, which is guarded by three very rudimentary valves, and the left auriculo-ventricular foramen, which presents no indication of valve. The ventricles intercommunicate due to the failure of the development of the interventricular septum.

The ventral heart presents comparatively small auricles which are, however, apparently normal in structure. They are connected by a rather wide foramen ovale, due to incomplete development of both septum primum and septum secundum. There is no blood vessel communicating with the left auricle. The wall of the right ventricle is as thick as that of the left one, otherwise the ventricles are normal.

The principal arteries.—Arising from the left ventricle of the ventral heart is a fairly good sized ascending aorta (3) which bifurcates one centimeter from its origin into a right and left aortic arches (4, 5), the left arch is much larger than the right one. The brachiocephalic artery is absent, so the right and left common carotid arteries and the brachial arteries of the right and left bodies arise separately from the aortic arch of their respective side. One-half centimeter beyond the point of bifurcation, the left aortic arch gives off the left common carotid artery (6) which terminates anteriorly in occipital and internal and external carotid arteries (7, 8, 9). The right common carotid artery (10) is much smaller in caliber than the left one, and is given off a little beyond the origin of the right aortic arch. It terminates anteriorly in similar fashion as its fellow on the other side. Almost opposite its origin the right aortic arch is joined by the ductus arteriosus (11) of the ventral heart, which is, in turn, joined by the

ventral pulmunary artery (12), just before it opens into the aortic arch. The right aortic arch is also joined by the ductus arteriosus (13) of the dorsal heart about one centimeter from its junction with the ventral ductus arteriosus. Upon dissection the ductus arteriosus of the dorsal heart proved to be completely obliterated at its origin, having no communication at all with the ventricular cavity. The dorsal pulmunary artery (14) joins it a little distance from its origin.

The right and left brachial arteries (15, 15′) of each body arise separately from their corresponding aortic arch, and before emerging from the thorax they give rise to the vertebral and internal thoracic arteries (16, 16′ and 17, 17′) of their respective side; the internal thoracic arteries are given off just before they turn around the anterior borders of the first ribs.

The coeliac branch (18) of the left descending aorta has no homonymous artery on the right one, and its principal branches ramify chiefly in the dorsal spleen. The blood supplies of the stomach, liver, pancreas, intestines, and ventral spleen are derived chiefly from the anterior mesenteric branches (19, 19′) of the right and left descending aortae (20, 20′). The renal arteries (21, 21′) and other branches arising from the aortae, although not represented in the figure, show no special characters. There are four umbilical arteries (22, 22′) present, each arising from its corresponding iliac or hypogastric artery (23, 23′).

The principal veins.—There are four veins emptying into the right auricle of the ventral heart—anterior vena cava (24), posterior vena cava (25) of the right body, and posterior vena cava (26) of the left body. The anterior vena cava returns to the heart the blood from the right side of the head and neck and the anterior limbs and part of the thoracic wall of the right body. It is formed by the confluence of the right external jugular (27) and the common trunk (28) formed by the union of the right and left brachial veins of the right body. The left external jugular vein (29) drains the left side of the head and neck and opens into the left posterior vena cava, a little distance before the latter pierces the ventral pericardium. Before entering the thorax, it is joined by the right and left brachial veins of the same side. The internal jugulars which are normally large in pigs are absent here.

The posterior vena cava of the right body receives the two hepatic veins (30), just before it reaches the foramen venae cavae of the diaphragm. The posterior vena cava of the left body passes thru the foramen hiatus aorticus in company with the left descending aorta. A little medial to its junction with the left external jugular vein, it is joined by another blood vessel arising from the right auricle of the dorsal heart; it is called here the anterior vena cava (31) of the dorsal heart. The renal veins and the common iliac veins (32, 32′) of both the right and left bodies present no special features of importance.

The abnormally large ductus venosus (33) is imbedded in the substance of the ventral lobe of the liver, connecting the large umbilical vein (34) and the hepatic veins. The portal vein (not indicated in the figure) enters the liver at a small depression on the dorsal surface of the ventral lobe.

The left auricle of the dorsal heart receives a large blood vessel which traverses the thoracic wall of the right side of the left body. Its principal branches ramify in the dorsal spleen and in the left dorsal portion of the diaphragm. This blood vessel is called here the "vena hemiazygos" (35).

THE SKELETON

(PLATE III, FIG. 1)

The bones of the extremities, anterior and posterior, are all fully and equally developed and show no special characters that deserve attention. There are present two vertebral columns, each of which presents the normal number of vertebrae and articulates anteriorly with the occipital and temporal bones of the corresponding side of the skull. The comparatively short bodies and spinous processes of the last four cervical vertebrae are more or less fused, which possibly may explain the relative shortness of the neck.

The thorax is compound. It is bounded by fifty-six well developed ribs which constitute the normal number for two individuals. There are two sterna, dorsal and ventral; the latter is much better developed. The dorsal and ventral chondro-sternal articulations are rather asymmetrically arranged, viz., those of one side are not found exactly opposite those of the other. This condition may readily suggest that each sternum was formed by the fusion of the parts of the sternum of the right body with their corresponding parts of that of the left one.

The skull is apparently normal in size and shape, and presents the normal number of bones that make up the skull of a single individual. Of the cranial bones, the parietal and occipital only present special features that deserve notice. The former fails to meet and fuse with its fellow on the opposite side, thus creating an irregularly oval opening (1) into the cranial cavity; and the latter fails to develop with the parietal the nuchal crest which is very prominent in normal pigs. The foramen magnum (2) is abnormally small and closed by a fibrous connective tissue membrane which is firmly attached around its margin.

THE NERVOUS SYSTEM

(PLATE III, FIG. 2)

The peculiarities of the central nervous system of this monster pig coincide almost entirely with the description by Williams and Rauch. The cerebrum (1) is single, presenting on its dorsal and lateral surfaces indistinct gyri and sulci which are very irregularly arranged. The optic nerves and the olfactory bulbs (2) are normal for a single individual.

The cerebellum (3) shows distinctly the right and left cerebellar hemispheres and the median vermis. The medullas (4, 4′) are partly united anteriorly, otherwise the remainder of the cerebro-spinal axes is normal for each body.

ACKNOWLEDGEMENT

The writer wishes to express his sincere thanks to Mr. Deogracias Villadolid of the Department of Entomology-Zoology for the privilege of dissecting the pig here recorded.

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ILLUSTRATIONS

PLATE I

Fig. 1. Dorsal view of the monster.
Fig. 2. Ventral view of the monster.

PLATE II

Fig. 1. Ventral view of the respiratory and digestive systems; the lungs, stomach, and pancreas are ¾ of their actual size.
Fig. 2. Ventral view of the blood-vascular system with the dorsal heart (2) so reflected that its dorsal aspect is seen in the figure. The hearts are ¾ of their actual size.

PLATE III

Fig. 1. Dorsal view of the skeleton without the dorsal anterior extremities.
Fig. 2. Dorsal view of the cerebro-spinal axes.

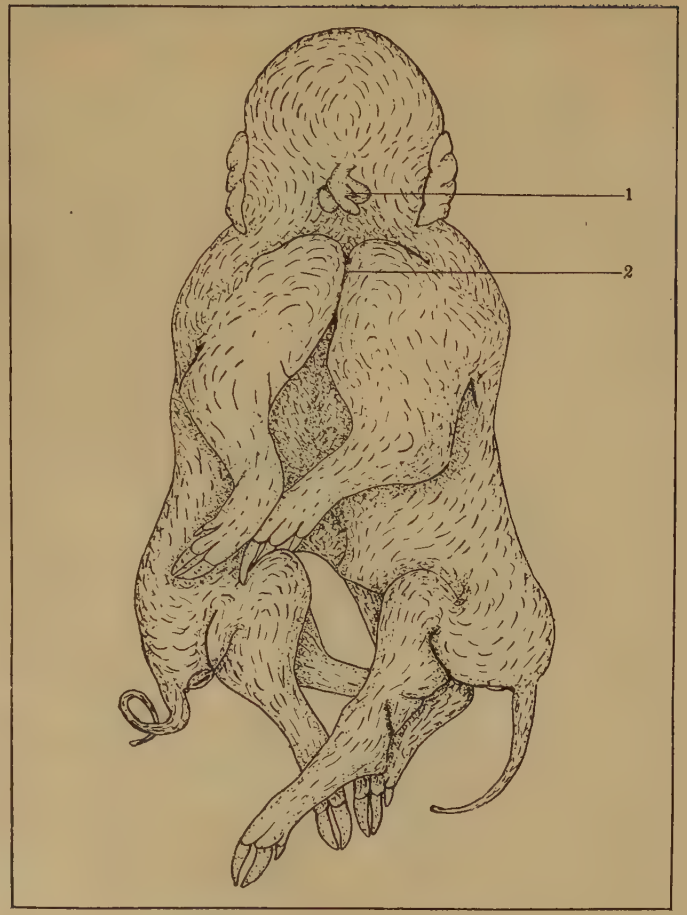

Fig. 1. Dorsal view of the monster.

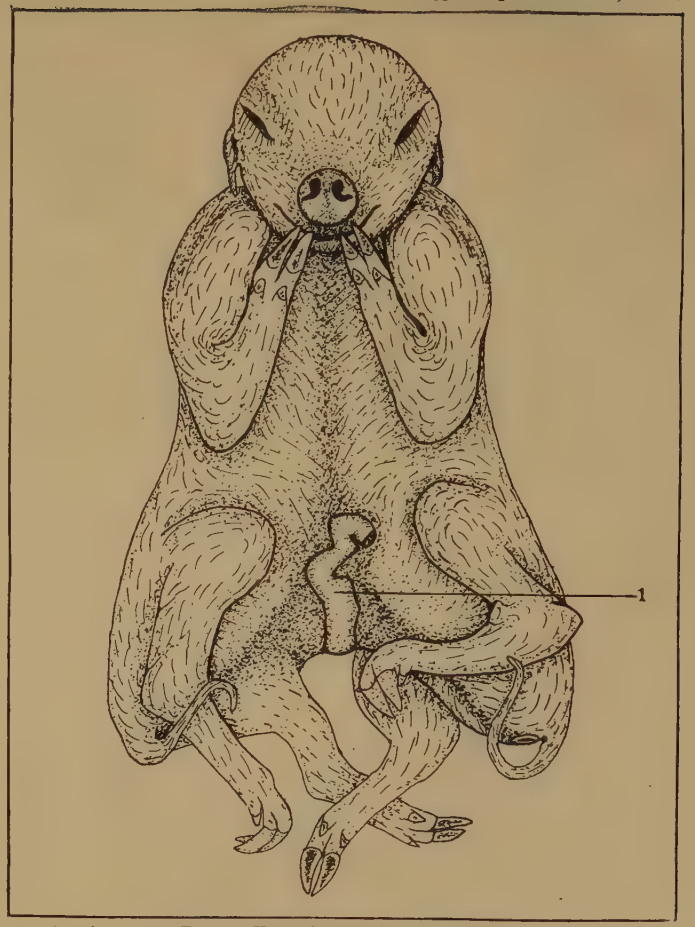

Fig. 2. Ventral view of the monster.

PLATE I

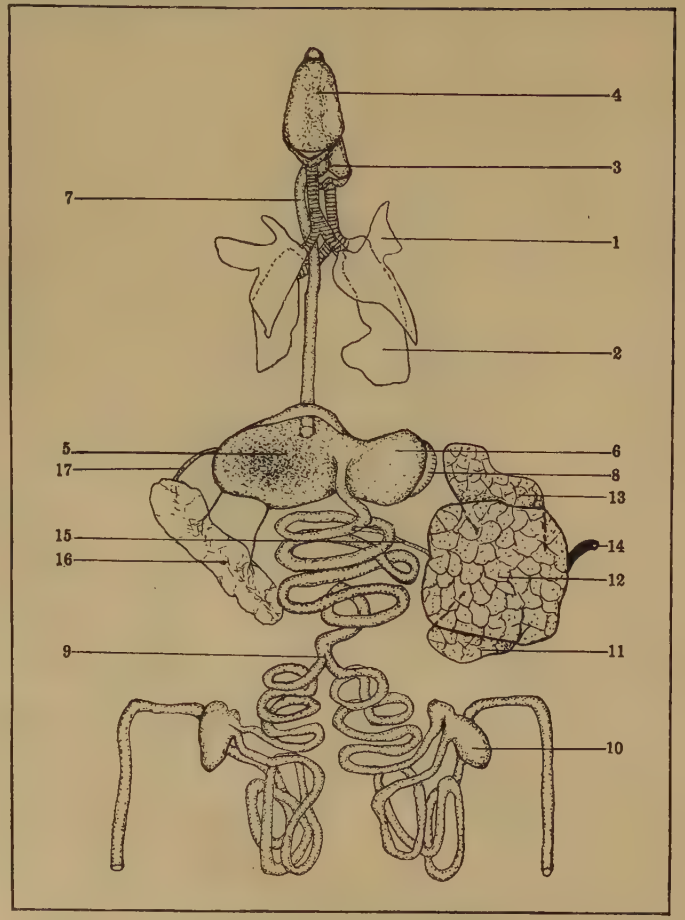

Fig. 1. Ventral view of the respiratory and digestive systems.

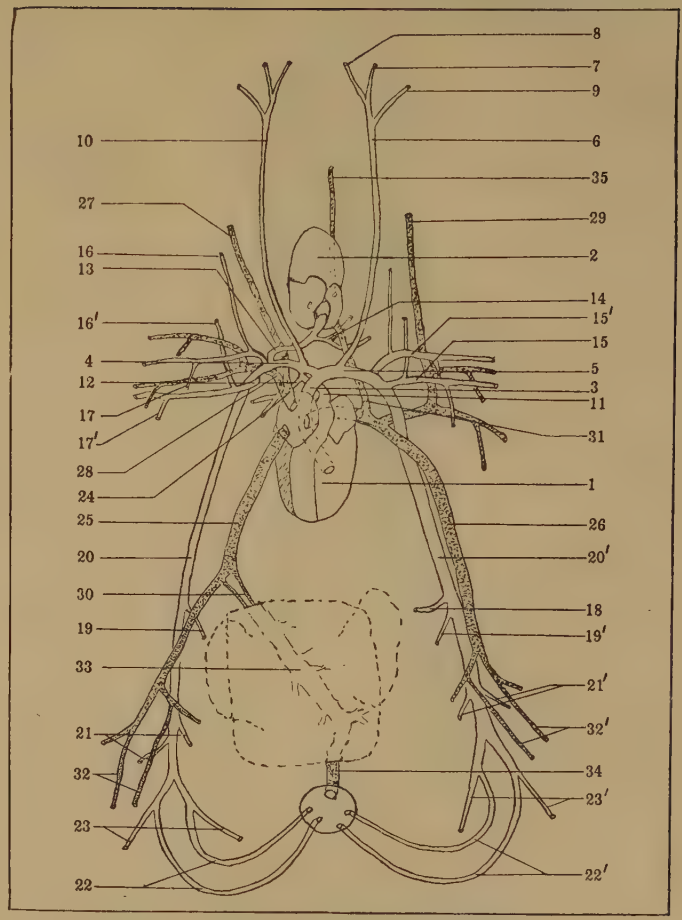

Fig. 2. Ventral view of the blood-vascular system.

PLATE II

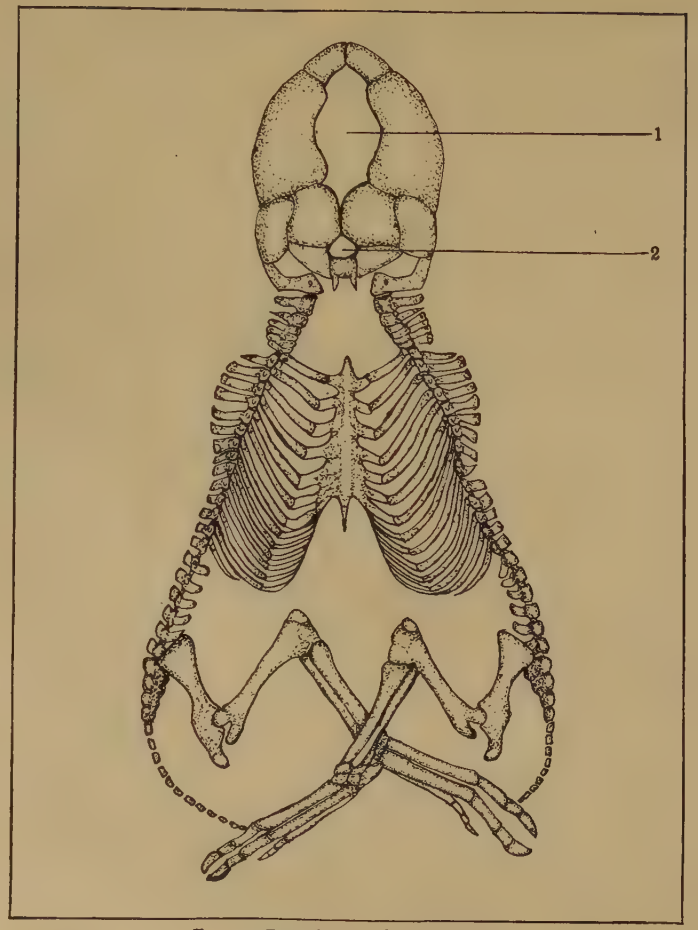

Fig. 1. Dorsal view of the skeleton.

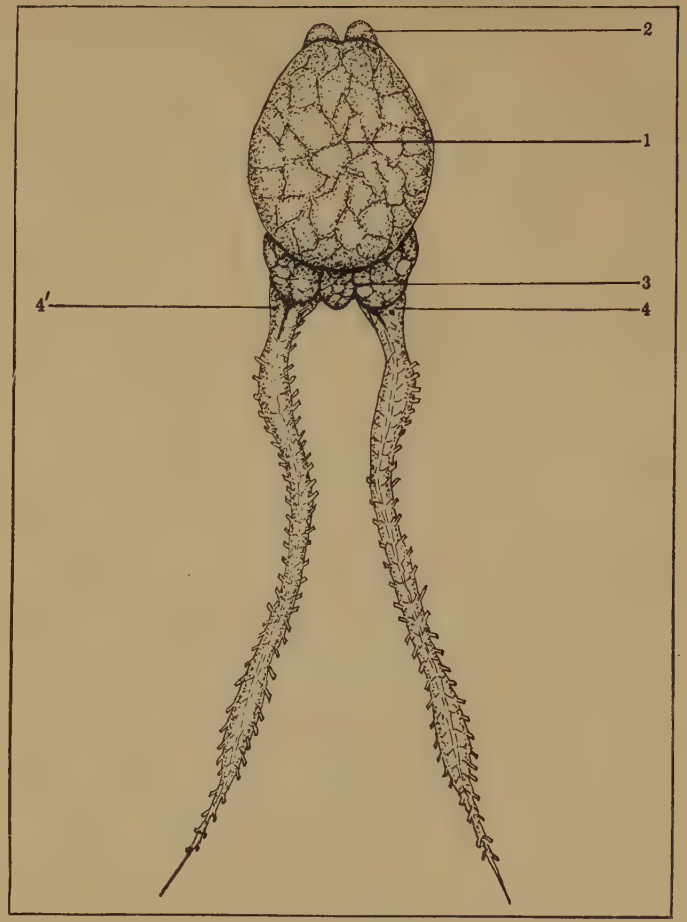

Fig. 2. Dorsal view of the cerebro-spinal axes.

PLATE III

CYANOPHORIC PLANTS OF THE MAKILING REGION[1]

By D. A. Herbert

Of the Department of Plant Physiology

That hydrocyanic acid is widely spread through the plant kingdom is a well known fact. Greshoff (1) working at Kew and Haarlem has drawn up a long list of cyanophoric plants belonging to widely separated families. Similar work is at present being carried out by Smith and White (2) (3) in Queensland, where a systematic examination of the flora is being made. Such work is valuable from an economic standpoint in affording an indication of possible losses of stock from eating these plants, and the present paper is a contribution towards the local study of the subject. It is not an exhaustive list even for the limited area with which it treats, but the common native species, introduced fodder and food plants, ornamental plants and weeds have been dealt with. Most of the examinations were made by graduate students working under supervision on a course of plant nutrition at the College of Agriculture during the summer of 1922.

A point to be noted is that the amount may vary greatly in different individuals of the same species. Further, the method of testing is important, and must be sufficiently delicate to produce a reaction in the presence of very small amounts, as in the case of the majority of plants examined the percentage of hydrocyanic acid is very low. Two modifications of Guignard's test were used; first, the hanging of a strip of moistened sodium picrate paper in a tube containing the material. and second, the immersion of the material in sodium picrate solution to which a little chloroform had been added. A large number of plants though giving rather rapid reactions with the second method were either extremely slow or did not give any reaction with the test papers. Those with a higher percentage showed a positive reaction readily with the sodium picrate paper, but when there was only a trace of hydrocyanic acid present the method was not successful in a large number of cases. As examples the following plants may be cited: *Mimosa pudica*, *Bauhinia malabrica*, *Cyperus rotundus*, *Dillenia indica*, *Phaseolus lunatus*, *Cecropia palmata*, *Caryota cumingii*, *Citrus decumana*, *Mangifera indica*, and most of the palms examined. A reaction which showed on the test paper only after several hours exposure was shown in a few minutes by the method of immersion of the tissue being examined.

Where the material was available, roots, stems. leaves, flowers, and fruits were examined and the results show considerable variation in amount. The following is the list of plants examined, and it will be seen that the majority proved to be cyanophoric in a greater or lesser degree.

ACANTHACEAE

Graptophyllum pictum (Marado): Slightly positive in bark, flowers, and leaves.

Amaranthus spinosus: The leaves contain traces of hydrocyanic acid, but those of *A. viridis* (Colites) contain none.

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[1] Experiment Station contribution, No. 88.

ANACARDIACEAE

Buchanania arborescens (Balinhasay): Stem and leaves positive, a large amount being present in the leaves.

Mangifera indica (Mango): Bark positive, leaves negative.

ANONACEAE

Anona muricata (Guanabanos): All parts positive especially the bark which contains large amounts of hydrocyanic acid. The leaves contain rather less, the roots less and the fruits only a trace.

Anona reticulata (Anonas): The content was lower in this species. Fruits were not available for examination. The distribution in the bark, roots and leaves was somewhat different from that in *A. muricata* the greatest amount being in the bark, the next in the roots, whereas in the leaves it was only in minute traces.

Canagium odoratum (Ilang-ilang): Slightly positive in bark, flowers and leaves.

APOCYNACEAE

Taternaemontana subglobosa (Pandakaki): Leaves and bark faintly positive, flowers negative.

ARACEAE

Alocasia indica (Biga): A slight trace in the tuber, none in petiole or leaf.

Alocasia macrorrhriza (Wild Gabi): Negative in all parts.

Alocasia portei (Biga): Negative.

Alocasia sanderiana (Wild Gabi): Slightly traces in tuber and petiole; none in the leaf.

Caladium bicolor (Ornamental Gabi): Negative.

Colocasia esculentum (Taro): Negative.

Colocasia zebrina (Ornamental Gabi): Positive in all parts; more so than the other members of the family listed.

Xanthosoma sagittifolium (Wild Gabi): Very slight traces in tubers, petioles and leaves.

ARTOCARPACEAE

Artocarpus integrifolia (Jak-fruit): Bark and leaves faintly positive.

BALSAMINACEAE

Impatiens balsamina (Camantique): A trace in the flowers, slightly more in bark and leaves.

BIGNONIACEAE

Spathodea campanulata: Bark, leaves, and roots positive.

CARICACEAE

Carica papaya (Papaya): Hydrocyanic acid absent from all parts of the papaya including the fruit.

CELASTRACEAE

Spondias lutea: Slightly positive in bark and flower, but negative in the leaves.

COMBRETACEAE

Quisqualis indica: Slightly positive in the leaves, more so in the bark.

COMPOSITAE

Erigeron linifolius: Leaves and roots slightly positive; bark negative.

Vernonia cinerea and *V. patula:* Both these species showed traces in all parts.

CONIFERAE

Agathis alba: Leaves gave a faint reaction.

Cryptomeria japonica: Negative.

CONVOLVULACEAE

Ipomea batatas (Camote): Traces in stem, leaves, fruits and roots; in some cases absent altogether.

Quamoclit acutangula (Cabello del angel): Positive in leaves, a faint trace in stem, flowers, roots, negative in fruits.

CUCURBITACEAE

Cucurbita acutangula: Positive in leaves, a faint trace in stem, flowers and roots, negative in fruits.

C. cylindrica: Negative.

C. maxima: Faint traces in stems, leaves and roots, but flowers and fruits negative.

C. pepo: Negative in fruits.

CYPERACEAE

Cyperus rotundus: Positive in leaves, stems, roots and rhizomes.

DILLENIACEAE

Dillenia indica (Catmon): Slightly positive in the leaves.

EUPHORBIACEAE

Bischofia javanica: Leaves faintly positive; some negative.

Codiaeum variegatum (San Francisco): Bark and leaves positive the former containing the greater quantity.

GRAMINEAE

Andropogon citratus: Traces in leaves, roots.

Cynodon dactylon (Bermuda Grass): Traces in leaves, stems and roots.

Dactyloctenium egypticum: Negative.

Digitaria consaguinea: Traces in leaves, stems and roots.

Imperata cylindraca (Cogon): Traces in leaves and stems.

Leersia hexandra (Zacate): Traces in leaves and stems, with rather greater quantity in roots.

Oryza sativa (Rice): Very faint traces in stems and leaves, slightly more in the roots.

Panicum maximum (Guinea Grass): Traces in stems and leaves; rather more in roots.

Panicum crus-galli (Balili): Slight traces in all parts.

Paspalum dilatatum (Para Grass): Positive in all parts, and containing more than the other grasses examined.

Saccharum officinarum (Sugar Cane): A very faint trace.

Saccharum spontaneum (Talahib): Positive in all parts, the leaves containing most, the stems less and the roots least.

Zea Mais (Maize): Positive in all parts but only a faint trace in the stem.

LAURACEAE

Cinnamomun camphora (Cinnamon): Faint trace in bark and leaves.

Litsea glutinosa: Bark, leaves and roots positive.

Persia gratissima (Avocado): Bark positive, a faint trace in the leaves and none in the fruit.

LEGUMINOSAE

Abrus precatorius (Saga-saga): Stems, leaves, and roots positive.

Acacia farnesiana (Aroma): A faint trace in stems, leaves and roots.

Albizzia procera (Acleng parang): A faint trace of absent.

Bauhinia malabarica (Alibangbang): Traces in the nature undried seeds; none in the dried.

Caesalpinia pulcherrima (Caballero): Positive in leaves, stem and roots.

Cajanus indicus (Cadios): Traces in leaves, stems and roots.

Canavalia ensifomis (Sword Bean): Negative.

Cassia alata: Positive in leaves, stems and roots.

Centrosema plumieri: Positive in the stem and roots, but faint traces only in other parts.

Desmodium scopirus: Traces in the leaves and still less in the stem, negative in the roots.

Derris philippinensis: Positive in bark, leaves and roots.

Dolichos lablab (Batao): Traces in leaves, stems and roots of both white and pink forms; a very definite reaction given by the seeds.

Erythrina indica (Dapdap): Traces in leaves, stems and roots.

Gliricidia sepium (Madre cacao): Faintly positive in the leaves, but more so in the bark and roots. The leaves also contain a fair amount of the volatile aldehyde coumarin, especially in the young stage. Some plants gave negative tests throughout.

Intsia bijuga (Ipil): A slight trace in the leaves. None at all in the bark.

Leucaena glauca (Ipil-ipil): Leaves, stems and roots contain traces.

Mimosa pudica (Macahia, Sensitive plant): Roots, stems and leaves positive, the roots containing most, the stems less, and the leaves still less.

Pachyrrhizus erosus: Traces in bark, leaves and roots.

Parkia timorana (Cupang): Bark, leaves and roots positive.

Phaseolus lunatus (Patani): Well marked reaction from the stem. A trace in the leaves and none in the roots. The mature seeds contained a large quantity of prussic acid. This is not in keeping with the findings of Dunstan that *Phaseolus* lunatus produces prussic acid only in the wild state and loses it either entirely on except for a minute trace when it is cultivated. No wild plants were available for examination.

Pilecolombium dulce: Traces in bark, leaves and roots.

Psophocarpus tetragonobolus: Positive in the stems but with traces only in leaves and roots.

Tephrosia candida: All parts negative.

Vigna sesquipedalis: Negative.
Vigna sinensis: Negative.

LILIACEAE

Cordyline terminalis: Negative.

LOGANIACEAE

Strychnos nux-vomica (Strychnine): Positive in leaves, bark and roots.

MALVACEAE

Hibiscus rosa-sinensis: Negative in all parts.
Thespesia populnea: Negative in all parts.

MELIACEAE

Swientenia macrophyla (Mahogany): Varying amounts from a faint trace to fairly strongly positive. The leaves always with more than the bark.

MORACEAE

Cecropia palmata: Traces in leaves and fruits, more in the bark.

MYRTACEAE

Eugenia jambolana (Duhat): Negative in bark, leaves and roots.

NYCTAGINACEAE

Bougainvillea spectabilis: Negative.

ORCHIDACEAE

Vanilla planifolia: Negative.

PALMAE

Areca catechu (Betel Palm): Positive in leaf, stem and root; traces in the fibrous pericarp, but the mesocarp strongly positive.

Arenga pinnata (Cabo negro): Positive in the stem; traces only in fruit, flower, leaf and root.

Calamus sp. (Rattan): Traces in all parts.

Carludovica palmata (Panama Palm): Slight traces in all parts.

Cocos nucifera (Coconut): Strongly positive in the stem and the pericarp, and definitely positive in other parts.

Corypha elata (Buri Palm): Slight traces in all parts.

Dypsis madagascariensis: Slight traces in all parts.

Livistona rotundifolia (Anahao): Slight traces in leaves, stems and roots.

Normanbya merrillii (Bunga de China): Slight traces in leaves, stems and roots.

Oreodoxa regia (Royal Palm): Positive in stems and roots; traces in the leaves.

Phytelephas macrocarpa: Slight traces in leaves, stems and roots.

Ptychosperma macarthurii: Slight traces in leaves, stem and roots.

PASSIFLORACEAE

Passiflora rectangularis: Negative.
Passiflora quandrangularis: Negative.

PHYTOLACCACEAE

Phytolacca oleraceus: Negative.

PIPERACEAE

Piper betle (Betel pepper): Positive in the leaves, but very faint in other parts, including fruits.

POLYGONACEAE

Antigonon leptopus (Morning Glory): Negative.

PROTEACEAE

Grevillea robusta (Silky Oak): Positive in leaves, bark, root, more in the leaves than in the other parts. Smith and White examined this plant in Queensland, its native country, and found the foliage to give negative reactions. They also examined the flowers and seed, but the Makiling plants did not possess these and it remains to be seen if the these parts vary also in their prussic acid content.

ROSACEAE

Eriobotrya japonica: Negative in the fruit; slight traces in the bark and leaf.

RUBIACEAE

Coffea liberica (Coffee): Leaves and bark positive; roots negative.

RUTACEAE

Citrus aurantium, C. decumana, C. limonis, C. mitis and *C. nobilis* contain traces in bark, leaf, and fruit, *C. hystrix* and *C. trifoliata* have traces in the leaf, but none in the bark.

STERCULIACEAE

Sterculia carthaginensis: A trace in the bark and the leaves.

URTICACEAE

Laportea subclausa (Lipa): Strongly positive in leaves, bark and roots.

VERBENACEAE

Tectona grandis (Teak): Bark negative, leaves faintly positive.

From these results it will be seen that the distribution of hydrocyanic acid in different parts is not uniform, even in species belonging to the same genus (see *Anona*); that is, no part is found to contain more than the other parts in all the species examined. In the majority of cases the greatest amount is in the bark, but in by no means all. The amount also depends on individuality to a great extent, and locality play an important part. *Swietenia macrophylla* is a good example showing variation within a small area, and *Grevillea robusta* shows how the content may vary when the same species is raised in different countries.

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THE PARASITISM OF OLAX IMBRICATA[1]

By D. A. Herbert

Of the Department of Plant Physiology

ONE TEXT FIGURE

Olax imbricata, Blume (Malabaguio), is a large woody vine occurring sparingly in Mount Makiling. Phylogenetically the family Olacaceae comes very close to two notoriously parasitic families, the Loranthaceae and the Santalaceae. Most of the Loranthaceae are parasitic on branches, but one genus, Nuytsia (1), is a root parasite. The Santalaceae contain no members parasitic on branches, but a large number, and probably all, have been shown to be root parasites (2), (3), (4), (5). It is, therefore, to be expected that a similar property might be exhibited by the Olacaceae, and one member, *Olax scandens*, has been proved by Barber (6) to possess root attachments.

In appearance there is nothing in this species to suggest a heterotrophic habit. Its leaves are well developed, and were it not for its systematic relationships it might pass as a holophytic plant. An examination of its roots, however, shows that it is definitely parasitic. The root system is shallow and wide, the large rather soft roots branching and ultimately giving rise to fragile white roots which in contact with another root produce a lateral haustorium. This is of the same type as that found in the Santalaceae, and attains about the same size as that of *Fusanus spicatus* or of *F. acuminatus*. The shape of the mature haustorium is approximately like that of a mushroom with the pileus external to the host root, the gills pressed against the surface of it, and the stipe embedded in the tissue external to the wood. The position of the vascular tissue in the haustorium corresponds roughly to that of a layer several millimeters from the surface of the haustorium, i.e., it is in the shape of an inverted flask; the mouth of the flask being in contact with the wood of the host root. The *Olax* haustorium, therefore, obtains salts and water as well as organic matter from the host plant.

In a large *Olax* plant it is obvious that any particular root will have more chance of coming into contact with other roots of the same plant that with those of other species. This happens more particularly round the base of the plant where the root system is more centralized, and in this region a large number of haustoria are found on *Olax* roots. Self parasitism is the rule in root-parasitic plants, and *Olax* is no exception. There is no used to trace these roots back to the parent plant; they are very distinctive, soft and inclined to be fleshy, and devoid of root hairs.

The functional existence of the haustoria is limited. As the root grows they are forced outwards and perish, and scars are left to mark their point of attachment. They are invariably lateral in the specimens obtained, and this lends support to the theory that they are organs as distinct as leaves or flowers, and not modified roots.

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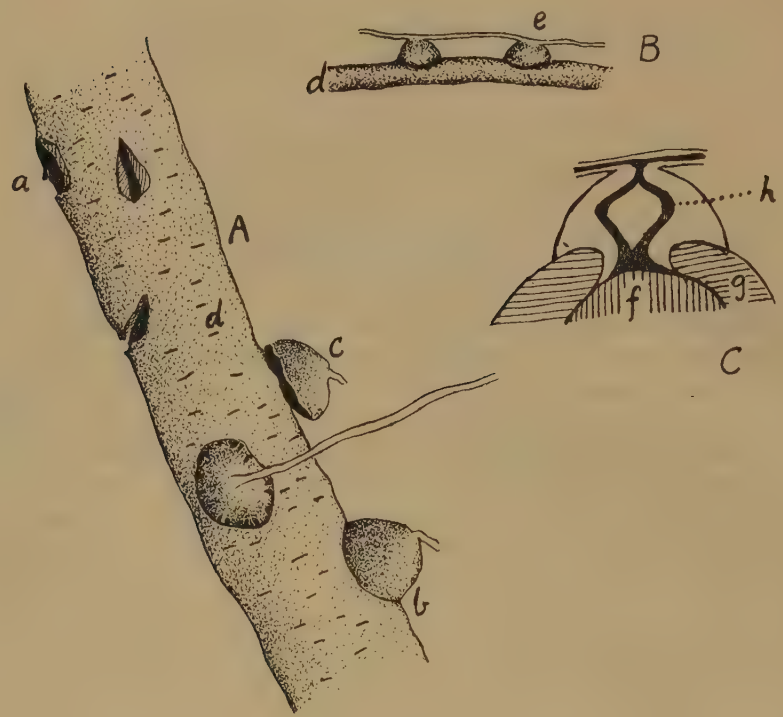
[1] Experiment Station contribution, No. 89.



PARASITISM OF OLAX IMBRICATA

A. Root of *Olax imbricata* attacked by its own haustoria.
   a. Scar left after death of haustorium,
   b. Mature haustorium really originally lateral but apparently terminal through death of distal portion of the root.
   c. Old haustorium being forced off by the growing root.
   d. Host root.
B. e. Young haustoria showing lateral origin.
C. Section of haustorium attacking root (diagrammatic).
   f. Host wood.
   g. Host cortex.
   h. Vascular tissue of haustorium.

There are three host plants found and two of these were legumes. The best development of haustoria, however, was found on the roots of *Olax* itself. Evidently the food material supplied by these is more nearly what the plant requires, and, therefore, haustoria reach their maximum development when attached to them.

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STUDY OF BUD VARIATION IN CODIAEUM VARIEGATUM[1]

By Nemesio B. Mendiola and Juan R. Magsino

Codiaeum variegatum (L.) Blume is a horticultural species to which has been applied the Filipino common names, San Francisco, Buenavista and Saguilala, and the English name, croton. According to Merrill[2] this species is, in repects to form and color of the leaves, the most variable in the Archipelago. A study of the variability in this species should prove of genetic and horticultural interest. Such a study might lead to a knowledge of the causes of such great variability and to a discovery of the way in which new types may be produced.

An ornamental so common and so widely distributed in the Philippines as this species deserves some attention in regard to improvement, or the beautifying of old forms and the creation of new forms, or types.

This work consists, among other things, of a familiarization with different forms, or types of San Francisco, and a study of such bud variations as may be found. Other objects of this investigation are to determine whether the variants found give rise to permanent new forms or not and if permanent variations may be caused by variation in soil and light conditions.

This work was carried on in the College of Agriculture, University of the Philippines, Los Baños, beginning June, 1920, and ending July, 1922.

MATERIALS AND METHODS

All available varieties of *Codiaeum variegatum* growing on the College of Agriculture grounds as well as some varieties growing in Lemery and Taal, Batangas, were studied. General observations were also made of the varieties found in barrios of Los Baños, and in different sections of Manila. Sixteen varieties were described. The descriptions appear in Table I.

EXPERIMENTS AND RESULTS

CUTTINGS, BEDS, AND PLANTINGS

Thirty-six cuttings were obtained from each of the varieties used and made to root in a bed of medium sand soil in the upper College Nursery. The cuttings were made uniform, at a length of about 18 centimeters. After the cuttings rooted and produced about eight to ten pairs of leaves each they were transplanted to two groups of beds under two different sets of conditions. One group was under artificial shade and the other was exposed to direct sunlight from half past six o'clock in the morning to half past five o'clock in the afternoon. There were three beds in each group. One bed contained ordinary farm soil; the second, ordinary soil mixed with about an equal amount of sand; and the third, farm soil mixed with an approximately equal quantity of decomposed horse manure. Each bed was one half meter deep, and the cuttings were set about 30.5 centimeters

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1 Experiment Station contribution, No. 90. Thesis combining a thesis presented for the Degree of Bachelor of Agriculture by Juan R. Magsino, No. 143.

2 Merrill, E. D., A Flora of Manila, 490 pp., 1912. Bureau of Printing, Manila.

apart each way. Each of the six beds in the two sets was planted with six cuttings of each variety.

STUDY OF VARIATIONS

Two kinds of bud variations were observed in the species. One kind was in the general coloring and spotting of leaves, while the second was in the shape, or form of leaves. A very conspicuous example of the first was found in variety No. 16, and of the second, in varieties numbers 15 and 16. Modifications are common in most of the varieties in the species. The following variations were observed within individual plants:

Variety No. 1.—This produces branches that have various colored leaves. Some branches are almost all green in color while some are variegated with yellow coloration on the veins.

Variety No. 2.—This bears some branches with leaves very much smaller than the leaves produced by most of the branches.

Variety No. 3.—This variety has branches the leaves of which are heavily spotted with light yellow coloration. It also produces branches that bear leaves with only a slight spotting, yet appearing very much darker green. Sometimes some branches produce smaller sized leaves than others.

Variety No. 4.—Some branches have leaves that are all straight while other branches produce also leaves which are twisted and leaves which are slightly lobed in the middle.

Variety No. 5.—This variety sometimes produces leaves that are long and sharp pointed. The leaves on some branches have rounded ends. Some branches produce leaves that are less decorated with yellow coloration and thus they appear more green.

Variety No. 6.—This variety produces branches all of which are green. In general the leaves are heavily spotted with yellow.

Variety No. 7.—This produces branches which bear in general much smaller sized leaves than the others. They are shorter and narrower, and thus can be easily distinguished from the rest.

Variety No. 8.—Some branches of this variety yield leaves that are shorter and narrower than those of the general type.

Variety No. 9.—This produces branches that have shorter and narrower leaves than other branches have.

Variety No. 10.—Some branches of this variety produce leaves of a brilliant dark green, spotted with yellow, while others produce branches that are pale green with the same color spotting.

Variety No. 11.—There are observed branches that have leaves generally smaller than the leaves of other branches. Besides, the bright coloration of leaves found on some branches is absent on others. Some branches produce leaves that are entire.

Variety No. 12.—This variety possesses branches with green leaves at the apex, when in general more of yellow coloration is observed at this part.

Variety No. 13.—Some branches produce very dark green leaves, while in general the leaves produced by the branches are bright yellow, particularly those at the terminal portion. Some branches produce much smaller leaves than others.

Variety No. 14.—In this variety some branches have green leaves while others are tinted with yellow on the veins and on both upper and under surfaces.

Variety No. 15.—This variety looks just like a bud mutation produced by variety No. 6. This plant produces branches that have leaves which are more green than the others, due to the fact that they are less spotted with yellow. Besides, the leaves produced by some of the branches are shorter and narrower.

Variety No. 16.—This variety produces branches that bear all green leaves. This is an offspring of variety No. 6.

Variety No. 17.—This is practically the same as variety No. 15 except that here the yellow coloration on the leaves is very slight and the leaves thus appear generally green.

Variety No. 18.—This possesses some branches with straight leaves, and other branches with the leaves both straight and twisted.

Most of the variations described above are modifications and are not transmissible. This was shown by actual experiments of the Plant Breeding Class in this College and are to be supposed as merely due to differences in environmental factors. These variations have, therefore, not been a direct cause of the productions of new varieties in the period of this investigation.

BUD MUTATIONS

Only one variety was observed to produce bud mutations. This variety is No. 6. The mutation was observed in several plants,—in one plant grown in Lemery, Batangas, and in seven plants growing on the College Campus. One mutation consisted in the production of a lateral branch with longer and very much narrower leaves, like those of Variety No. 15. The other mutation consisted in the production of a branch with leaves still similar in shape to those of the parent variety but different in color, as the mutation is all green. The parent variety is green with small dots or spots of yellow. The first mutation, a change from short broad leaves to long narrow leaves is both lateral and terminal. Examples of the lateral and terminal bud sports are shown in Plate I, figures 1 and 2 respectively.

That the variations shown were mutations was proved by the fact that they grew true to type when cuttings showing variations in these two characters were cut from parent plants and planted.

A third bud variation observed in Variety No. 6, which variation is highly suspected as mutation, consists in a lateral branch with narrow leaves which tend to become a two-or three-part affair as shown in Plate II. The leaves vary in shape from that of the parent, becoming narrow in some and still narrower at the middle in others. Others are found with a tendril-like structure or the bare midrib coming out of the tip, the end of which tendril-like structure producing new leaves, to such an extent that a leaf may have three parts. This variation was discovered by Prof. Higgins on one of the plants on his yard.

DISCUSSION OF RESULTS

From the results of this work, it was found that bud variations were produced by subjecting the plants under various soil conditions. The plants were induced to form leaves of deeper color by manuring, and of lighter color by planting them in sand. Generally, those exposed to sunlight produced a brighter coloration of leaves than those kept under artificial shade. On the other hand

those under shade were taller, more slender and less branchy than the exposed individuals. Observations of bud modifications existing in the different varieties have shown that these varieties produce bud variations which are not heritable.

As has been previously explained, two kinds of bud mutations were found (a) lateral and a terminal bud mutations consisting in the production of longer and narrower leaves, and (b) bud mutation consisting in a branch with almost all-green leaves. These bud mutations were detached from their parent plants and planted as described. In either case, both kinds continued to grow true to type. An example of (a) is found in Plate I. This fact seems to indicate that the old variety No. 15 probably originated as a bud sport from variety No. 6.

SUMMARY AND CONCLUSIONS

1. Bud variations in the species *Codiaeum variegatum* were produced by manuring or by growing the plant in soil containing 50 per cent sand and 50 per cent ordinary farm soil, or by exposure to the sun or by artificial shading for more than one and one-half years.

2. A case of terminal and one of lateral bud mutation involving the same shape of leaf, and a change from broad to slender shape, was found in one variety, No. 6. In this variety also a bud mutation consisting in a change from green leaves spotted with yellow to leaves practically entirely green, was found.

3. An interesting case of a suspected bud mutation was found in which leaves tend to become a two-or three-part affair, the parts being connected with a tendril-like structure or bare midrib.

4. Non-heritable bud variations were found which were due probably to the varying conditions of nourishment, light, temperature and possibly other elements present in the environment.

ACKNOWLEDGEMENT

The writers are obliged to Mr. Jose M. Capinpin, graduate assistant in agronomy for his help, and to Mr. Artemio V. Mansa, graduate assistant in plant physiology for help in describing the varieties.

ILLUSTRATIONS

Plate I

Bud mutation in *Codiaeum Variegatum.*
Fig. 1. Lateral bud mutation.
Fig. 2. Terminal bud mutation.

Plate II

A possible bud mutation of Variety No. 6, Fig. *p* shows typical parent leaf. The rest are leaves of the plant constituting the bud variation.

Variety number.	Leaf Characters.								
	Apex.	Margin.	Texture.	Arrangement.	Form.	Color.		Succession of leaves on stem.	Length and greatest width of leaves.
						Young leaf.	Old leaf.		
1	acute	entire	leathery	spiral	lanceolate	green	few dots	some portions are crowded	*cm.* 23 x 4.5
2	acute	wavy	leathery	spiral	ovate	—	dark purple	regular	8.5 x 3.0
3	obtuse	lobed	leathery	spiral	3 lobed obovate	green	green with yellow dots	regular	1.2 x 5.5
4	obtuse some are mucronate	entire	leathery	spiral	linear	green	lamina purple, midrib red	regular	29. x 1.0
5	rounded some lobes acute	entire to cleft	leathery	spiral	various forms	green with yellow spots	green with yellow spots	regular	9.0 x 3.0
6	acute	entire	leathery	spiral	obovate	green with yellow dots	greenish yellow	regular	2.0 x 4.0
7	acute	entire	leathery	spiral	linear,lanceolate	dark green yellow midrib	light green with midrib and yellow spots	regular	35. x 3.0
8	acute	entire	leathery	spiral	linear,lanceolate	dark green yellow midrib	see remarks	regular	35. x 3.0
9	acute	entire	leathery	spiral	linear,lanceolate	dark green	see remarks	regular	25. x 1.5
10	acute	entire	leathery	spiral	elliptic	dark green with yellow dots	dark green with abundance of yellow spots	regular	26.5 x 6.0
11	acute	slightly-lobed	leathery	spiral	slightly obovate 3 lobed	dark green with yellow dots	see remarks	regular	20.0 x 7.0
12	acute	entire	leathery	spiral	linear	yellowish green	see remarks	regular	35.0 x 3.0
13	obtuse	entire	leathery	spiral	oval	green	see remarks	regular	1.5 x 6.5
14	acute	cleft	leathery	spiral	3 lobed obovate	greenish	green spotted with yellow	regular	28.2 x 5.5
15	mucronate	entire	leathery	spiral	linear	greenish dot with yellow spots	yellowish dotted with green	regular	13.5 x 1.0
16	acuminate	entire	leathery	spiral	obovate	greenish	green with few yellow dots	regular	10.0 x 3.0
17	acute	entire	leathery	spiral	linear	greenish	greenish with few yellow dots	regular	13. x 1.0
18	mucronate	entire	leathery	spiral	linear	green	purple with greenish midrib	crowded at some portions	19.0 x 2.0

m variegatum used in the study.

				Vigor of plant.	Value of variety as ornamental.	Remarks
Branching.	Abundance of leaves.	Surface.	Color of petiole.	Nature.	Appearance.	
amount	medium	shiny	green to purplish	rapid growing	fair	
hing, fair	medium	shiny	green to purplish	slow growing	good	
——	medium	shiny	green to light purple	fairly rapid growing	not desirable	
——	profuse	shiny	green to purple	fairly rapid growing	good	Some leaves are parted forming two series of leaves like on a petiole.
——	profuse	shiny	greenish	slow growing	superior	Very great variation of leaves, some have extra outgrowth of the midrib and some are lobed.
hing, fair	profuse	dull	greenish	fairly rapid growing	fair	Parent of variety No. 15.
branching	medium	shiny	greenish	fairly rapid growing	fair	
branching	medium	shiny	green to purplish	fast growing	good	The upper surface of old leaf is greenish with yellow dots and the midrib is somewhat red; lower surface purplish.
hing, fair	medium	shiny	purplish	quite slow growing	good	Upper surface dotted with yellow and red; lower surface purple, midrib red.
hing, fair	medium	shiny	green to light purple	husky growing	good	
amount	medium	shiny	whitish purple	husky growing	very good	The leaves are from green to purplish.
amount	medium	shiny	greenish purple	——	good	Greenish spotted with yellow with yellowish midrib.
branching	medium	shiny	greenish	slow growing	good	Some leaves are purplish green with yellow spots; some are almost yellowish purple.
hing, fair	medium	shiny	greenish	rapid growing	fair	
	medium	shiny	greenish	slow growing	good	Bud offspring of variety No. 6.
——	medium	shiny	greenish	rapid growing	poor	Parent of variety No. 17.
——	medium	shiny	greenish	slow growing	good	Bud offspring of variety No. 16.
hing, fair	medium	shiny	greenish purple	dwarf	superior	Some leaves are spirally curved and some are wavy while some are almost straight.

Fig. 1. Lateral bud mutation.

Fig. 2. Terminal bud mutation.

PLATE I. BUD MUTATION IN CODIAEUM VARIEGATUM.

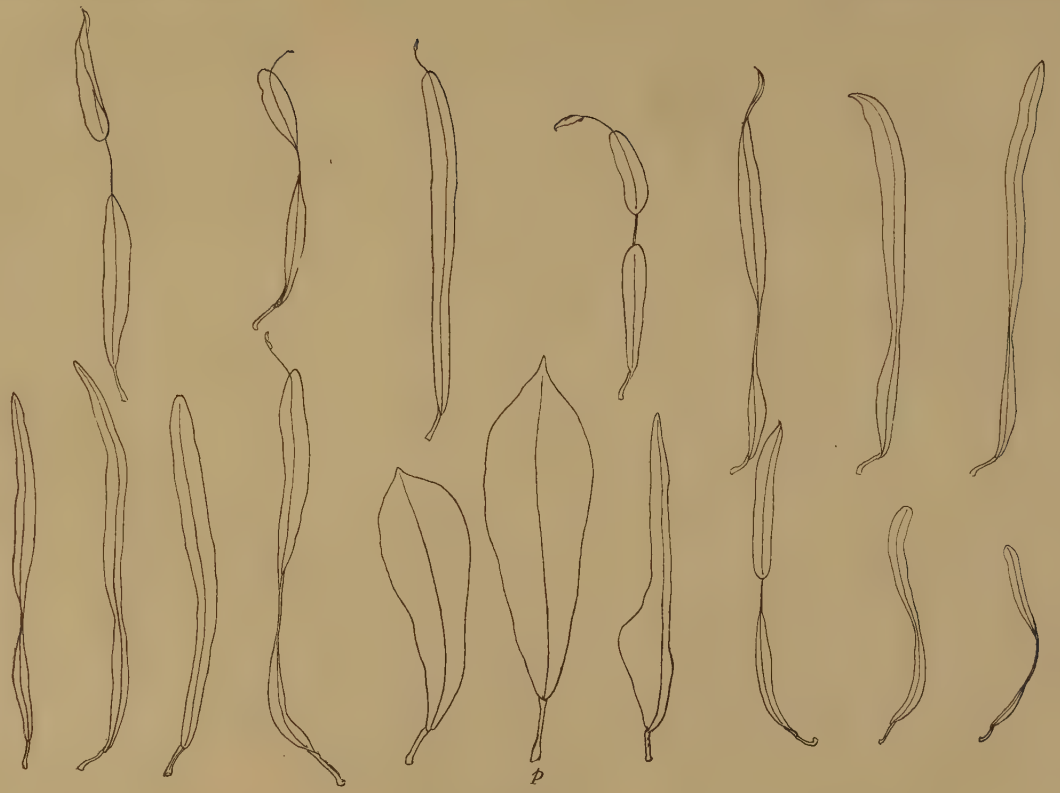

PLATE II.

REVIEW

Continuous renewal of nutrient solution for plants in water culture, Trelease, Sam. F., and Livingston, Burton E. (*Science 55: 483-486. 1922.*)—As the science of plant physiology progresses from an impirical collection of observations of results to a systematic study of underlying causes, so new needs arise in technique. Take nutrition, for instance. Hitherto we have been studying the behavior of plants grown on solutions which we change at intervals in order to renew the supply of solutes which have been absorbed. Such a procedure, however, is open to serious objections. Suppose the solutions are changed every three days. What is happening between these changes? As soon as a change is made the plant commences its differential absorption of the different salts in solution and gradually their relative proportions are changed. Then on the third day the solution is renewed and the plant is suddenly subjected to a new series of conditions. It is a matter of common knowledge that sudden changes of conditions are more injurious than the conditions themselves may be. The more frequently, therefore, that the solution is changed in a nutrition experiment, the less violent the change of conditions.

It is to Trelease and Livingston that we are indebted for an ingenious piece of physiological plumbing whereby a constant flow of nutrient solution into the culture jar is ensured. A system of syphons is arranged between a large stock vessel and the bottom of the culture jar, and the rate of flow of the solution may be regulated by very simple adjustments. An exit tube at the top of the culture jar carries off excess solution. As a result the whole culture medium is constantly moving through the jar, and the nutrients supplied to the plant are practically uniform.

Reviewed by D. A. Herbert.

COLLEGE AND ALUMNI NOTES

His Excellency Leonard Wood, Governor-General of the Philippine Islands, inspected the Los Baños Colleges on July 19, and addressed the students from the porch of Administration Hall. The trend of his speech was the need of the Islands for trained agricultural producers in order that civilization, wealth, and good government may go forward.

Dr. Guy Potter Benton, the President of the University, formally opened the college of agriculture on June 13. He was accompanied by cadet commandant captain Davis.

Professor Baker resumed his position as Dean of the College of Agriculture on July 5, relieving Professor Roxas who had been acting since commencement.

Dean Baker was absent during the latter part of May and all of June, making an inspection trip through the Christian provinces of Northern Luzon, in company with and assisting Mr. Silverio Apostol, the Undersecretary of Agricultural and Natural Resources. The party went overland from Ilocos to the Cagayan Valley by the Claveria trail, and were some five weeks in the saddle. Many rich and beautiful regions were traversed, that are rarely visited by public officials, and much important data gathered. They returned through Nueva Vizcaya, over the Santa Fé trail to Cabanatuan.

Professor Hester was appointed to the position of Acting Registrar *vice* Dr. Mirasol, on March 15.

Professors Woodworth and Hester spent the latter part of April on a walking tour from Baguio, Mountain Province to Aparri, returning to Manila by boat.

Professor Emma S. Yule, left early in April on leave of absence for the United States. She expects to spend some time in Japan doing literary work.

Professor Higgins made two trips during the long recess, one to the southern islands and Mindanao, and one to Baguio. He collected valuable agronomical data especially in the vicinity of the Trinidad Valley.

Professors Koster and Ashcraft of the College of Veterinary Science spent several weeks in May at Baguio doing manuscript work.

Professor Lester Cook Neer left for the United States on June 25 due to continued ill-health.

Professor Schwartz was a Baguio visitor during the hot months.

Associate Professor Paul L. Pearl has been transferred from the College of Liberal Arts to the College of Agriculture where he is at present in charge of the Department of English.

Associate Professor Colin G. and Assistant Professor Doris B. Welles left on June 25 for the United States.

Assistant Professor Taylor took teacher's leave in Baguio during April and May.

Assistant Professor Mirasol has been appointed Dean of the Junior College of Liberal Arts in Cebu.

Dr. Leopoldo B. Uichanco returned from the United States and assumed duty as Assistant Professor of Entomology on May 16. He received the degrees of M. S. and Sc. D. from Harvard University, where he had been for several years a pensionado.

Dr. Francisco O. Santos returned from the United States and assumed duty as Assistant Professor of Chemistry on May 18. He had been for several years a pensionado, and received the degree of Ph. D. from Yale University. Dr. Santos's specialization was nutrition. He worked at Minnesota, Columbia and Cornell Universities. His Doctor's dissertation was "Studies in the nutrition of the Filipino".

Mr. Mariano B. Raymundo, B. S., has been appointed Assistant Professor of Agronomy and made Farm Superintendent. Mr. Raymundo established the work in Rural Economics several years ago, since which time he has been employed on Dr. Copeland's estate at Chico California. He has direct charge of the courses in farm management.

Dr. Francisco M. Fronda arrived in the Islands on April 21st and took up his position as Instructor in Animal Husbandry. He received the degrees of M. S. and Ph. D. from Cornell University where he went as a pensionado. He was elected a member of Sigma Xi. Dr. Fronda majored in poultry husbandry, and collaborated with Professor Maynard in the publication of some very important investigations in poultry husbandry.

Dr. Valente Villegas, accompanied by his wife and family, returned on June 29 from the United States, where he had been pursuing advanced work in the University of Illinois from which institution he received the degree of Doctor of Philosophy. His dissertation embodied valuable investigations in the field of poultry husbandry, which were conducted in collaboration with Professor Mitchell, and which are shortly to appear in published form.

Mr. José Velmonte, B. S. in Commerce, U. P., '22, has been appointed Instructor in Economics and assigned to the Department of Rural Economics. Mr. Velmonte was formerly in the Bureau of Commerce and Industry.

Mr. Hilarion Heneres has been appointed Instructor in Sugar Engineering to assist in conducting the Sugar Technology curriculum. Mr. Heneres is a graduate of the College of Engineering in the University of Illinois. He obtained valuable training in sugar work at the Audubon Sugar School of the University of Louisiana.

Mr. Bartolome C. Blanco, B.S., U. P., '22, has been appointed Instructor in Mathematics and assumed duty at the opening of the school.

The following graduate assistants have been appointed for the departments indicated: Roman P. Estioko (Plant Physiology), Juan Unite, Rafael M. Piguing, and Teofilo Novero (Agronomy); Severino Aquino (Entomology); Valeriano Sarmiento (Pathology) Felix Esguerra (Extension Service); Florencio M. Soliven (Chemistry).

The laboratory of Plant Physiology 1 has been moved to the Engineering laboratory and the space formerly occupied by it in Administration Hall has been made into class rooms thus relieving the entire east wing for the library.

Extensive repairs have been undertaken for the Engineering Laboratory and alterations effected in several other buildings.

The registration of students in the College of Agriculture on July 25 was 665 as against 622 for last year. A detailed analysis of the registration will be presented in the *Agriculturist* in the near future.

THE STRENGTH OF AN ANT

When a man runs at a speed of ten seconds to the hundred yards, people say it is wonderful. When a man lifts a load one and a half times his own weight, people call him a giant. Now read this and draw your own conclusion. It was a windy day, and while at dinner I noticed a grain of rice moving. Upon closer examination, I found a tiny ant carrying it along. Out of curiosity, I determined to find out the strength of the insect. I had the ant and the grain it carried weighed separately on an analytical balance with this result. Weight of the ant 0.000096 grams; weight of the rice grain 0.01017 grams.

The ant was strong enough to carry a load 105.94 times its own weight against a head wind of about 5 miles an hour. At this rate, if an ant was as large as a man of 50 kilograms weight, it would be able to carry a load of 5296.9 kilograms. Can any man carry a load of 106 times his own weight?

Contributed by Alexander Gordon.